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Ms. Donna R. Searcy,  
Secretary  
Federal Communications Commission  
1919 M Street, N.W., Room 222  
Washington, DC 20554

FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF THE SECRETARY

RE: Loral Qualcomm Satellite Services, Inc.,  
ET Docket No. 92-28 (File No. PP-31).

Dear Ms. Searcy:

Transmitted herewith for filing with the Commission in the above-referenced docket on behalf Loral Qualcomm Satellite Services, Inc., is an original and four copies of its "Supplement to Request for Pioneer's Preference."

Should there be any questions regarding this document, please communicate with this office.

Respectfully submitted,

*William D. Wallace*

William D. Wallace  
(Member of Florida Bar only)

Enclosures

ORIGINAL

Before The  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C.

In the matter of: )

LORAL QUALCOMM SATELLITE )  
SERVICES, INC. )

ET Docket No. 92-28

File No. PP-31

Request for a Pioneer's )  
Preference with regard to )  
Its Application for Authority )  
To Construct GLOBALSTAR, a )  
Low-Earth Orbit Satellite )  
Communications System )

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FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF THE SECRETARY

SUPPLEMENT TO REQUEST FOR PIONEER'S PREFERENCE

Respectfully submitted,

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Dated: June 12, 1992

## SUMMARY

Loral Qualcomm Satellite Services, Inc. ("LQSS") supplements its request for a pioneer's preference for GLOBALSTAR, a low-earth orbit satellite communications system, by providing the texts of patents (including recently-issued patents), studies and test reports detailing technology incorporated into the system. This information demonstrates conclusively that GLOBALSTAR is an innovative proposal which will provide the public with communications services not currently provided and the substantial enhancement of existing services, thereby meeting the Commission's criteria for the award of a pioneer's preference.

This supplement provides the texts of patents for aspects of the CDMA technology incorporated into GLOBALSTAR. These patents confirm the innovative nature of the technology which is part of LQSS's request for a pioneer's preference. The fact that a CDMA system patent was applied for in 1986 also demonstrates that the innovations embodied in GLOBALSTAR were on the drawing board in the mid-1980's, establishing the system as a true pioneering effort.

Also included in this supplement are studies and test results for mobile communications over both satellite and terrestrial CDMA systems. These tests results validate the technology covered by the patents, and confirm GLOBALSTAR as the product of pioneering technology in the field of satellite communications technology.

The material in this supplement and LQSS's prior pleadings on its request for a pioneer's preference establish that LQSS's request should be granted.

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- Exhibit G - United States Patent No. 5,056,109 - Method And Apparatus For Controlling Transmission Power In A CDMA Cellular Mobile Telephone System
- Exhibit H - Hughes MobileStar CDMA Modem Field Report
- Exhibit I - Draft Final Report for Hughes Communications on System Studies for a CDMA Mobile Satellite System
- Exhibit J - CDMA Formal Field Test Report

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FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C.

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To Construct GLOBALSTAR, a )  
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Communications System )  
\_\_\_\_\_ )

SUPPLEMENT TO REQUEST FOR PIONEER'S PREFERENCE

Loral Qualcomm Satellite Services, Inc. ("LQSS"), by its attorneys, hereby submits this Supplement to its Request for Pioneer's Preference under Section 1.402 of the Commission's Rules. LQSS has applied for a preference with respect to GLOBALSTAR, an innovative, low-earth orbit (LEO) satellite communications system, which will provide new and enhanced services, including radiodetermination and mobile voice and data communications, utilizing the Radiodetermination Satellite Service (RDSS) bands.

LQSS initially requested a pioneer's preference in its GLOBALSTAR application filed on June 3, 1991 (Pt. 1, pages 6-8). A separate pleading outlining more fully and updating that request was filed on November 4, 1991, concurrently with LQSS's Petition for Rulemaking. See Establishment of Procedures to Provide a Preference to Applicants Proposing an Allocation for New Services, 6 FCC Rcd 3488, 3492, ¶ 37 (1991) ("Pioneer's Preference Order").

LQSS's pioneer's preference request was accepted for filing and placed in ET Docket No. 92-28 (Public Notice Mimeo 22153, March 9, 1992); comments and reply comments on LQSS's Request were filed on April 8 and April 23, respectively.

In these prior pleadings, LQSS detailed the innovative technology which supports its request. Recently, the U.S. Patent & Trademark Office has issued patents for several aspects of the pioneering research incorporated into GLOBALSTAR. To ensure that the record before the Commission is complete, and in light of the Commission's recent rulings,<sup>1/</sup> this patent material is being submitted.<sup>2/</sup>

Not only does the grant of these patents support LQSS's claim that GLOBALSTAR technology is new and innovative, the issuance of the patents now also allows LQSS to place in the public record

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<sup>1/</sup> See Public Notice Mimeo No. 23116 (May 14, 1992) (announcing acceptance for filing of material submitted by Motorola Satellite Communications, Inc. on April 10, 1992); Public Notice Mimeo No. 23328 (May 29, 1992) (setting June 12, 1992, as deadline for filing comments on Motorola supplemental material).

<sup>2/</sup> This filing is, of course, not an additional request for a pioneer's preference, but rather a supplement to LQSS's previously filed request and supporting comments. LQSS believes that no motion is required for submission of these materials. If the Commission believes otherwise, LQSS hereby seeks such acceptance on the basis that the record in this matter would be incomplete (and, indeed, potentially misleading) absent inclusion of this material.

Under the circumstances, supplementing the record in this manner is proper. Patents for several of the innovations critical to GLOBALSTAR were issued in April, 1992, including patents issued after the dates established for filing comments and reply comments in this docket. The material attached as exhibits rounds out LQSS's request and comments. LQSS has provided this material to the Commission and interested parties, and welcomes comments.

proprietary information (now protected by the patents) illustrating the innovative technology which supports LQSS's request for a pioneer's preference and which demonstrates the feasibility of GLOBALSTAR as a low-cost, global communications system.<sup>3/</sup>

I. LQSS HAS DEMONSTRATED THAT THE TECHNOLOGY TO BE USED FOR GLOBALSTAR IS INNOVATIVE AND DESERVES A PIONEER'S PREFERENCE.

In its prior pleadings, LQSS has established that GLOBALSTAR merits a pioneer's preference because it is a technologically innovative and feasible system which will provide new and enhanced services to benefit the public interest.

A. GLOBALSTAR is technologically innovative. GLOBALSTAR incorporates innovative system design features as well as patented CDMA spread spectrum techniques for reuse of spectrum, all of which combine to create a high-capacity, low-cost system.

The technology required to implement this CDMA system is the subject of recently-issued (and pending) patents, as described further below. This innovative research allows GLOBALSTAR to provide new and enhanced communications services by greatly increasing the call capacity available for a limited amount of spectrum and by concurrently improving the reliability of the

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<sup>3/</sup> Of course, research and development for a communications system like GLOBALSTAR is an ongoing project even though -- as with GLOBALSTAR -- the status of the available information is sufficient to prove feasibility. In this way, innovative companies like Loral Aerospace Corp. and Qualcomm Incorporated, the shareholders in LQSS, propose to provide consumers with the new and innovative communications technology which the pioneer's preference rule is intended to foster.



signals. This efficient and effective use of spectrum is also coupled with the development of techniques for using relatively low-cost LEO satellites in the space segment.

These patented innovations demonstrate conclusively that, in its GLOBALSTAR application, LQSS has presented an "innovative proposal" that will lead "to the establishment of a service not currently provided or a substantial enhancement of an existing service," Pioneer's Preference Order, 6 FCC Rcd at 3494, ¶ 47, and thus meets the Commission's criteria for awarding a pioneer's preference.

B. GLOBALSTAR is technically feasible. While highly innovative, the technology embodied in GLOBALSTAR has already been proven to provide reliable communications service through a number of completed tests and experiments, outlined in LQSS's prior pleadings and below.

Indeed, as discussed below, tests have already been conducted (in 1986) to simulate the operation of a CDMA satellite system using the L-band. These tests demonstrated the feasibility of transmissions to and from mobile terminals over a CDMA satellite system, and established the viability of the system design which is now embodied in GLOBALSTAR.

C. GLOBALSTAR is spectrally efficient. Innovative CDMA techniques for reuse of frequencies and compression of signals are incorporated into GLOBALSTAR through the use of spread spectrum CDMA. For example, GLOBALSTAR's methodology for "soft handoffs" increases capacity without requiring more spectrum by reusing beams of neighboring satellites and neighboring beams of a single

satellite; innovative RAKE receiver architecture provides multipath diversity for the system, reducing the effects of fading, and thereby increasing capacity and reliability. These and other technological innovations ensure that a satellite system using CDMA makes the most efficient and effective use of scarce spectrum resources.<sup>4/</sup>

D. GLOBALSTAR would successfully serve the public.

GLOBALSTAR's proven technology and comparatively low capital requirements would facilitate construction and operation of the proposed system, and demonstrate its viability. The purpose of a pioneer's preference is to ensure that the public obtains the benefit of new communications services which are the product of innovative technology. Pioneer's Preference Order, 6 FCC Rcd at 3490, ¶ 18. By combining relatively low-cost satellites with high-capacity, efficient use of spectrum, LQSS is poised to achieve this goal and to bring the benefits of its innovative technology to the public.

II. LQSS'S REQUEST FOR A PIONEER'S PREFERENCE ENCOMPASSES INNOVATIVE TECHNOLOGY WHICH IS THE SUBJECT OF RECENT PATENTS.

GLOBALSTAR incorporates CDMA technology pioneered by Qualcomm, Incorporated to accomplish efficient use and reuse of spectrum. To date, the United States Patent & Trademark Office has granted seven patents for Qualcomm's CDMA technology (with

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<sup>4/</sup> A more complete description of CDMA generally can be found in QUALCOMM Incorporated's Request for Pioneer's Preference filed on May 4, 1992, in General Docket No. 90-314 (File No. PP-68), and as applied to LEO satellite communications systems in LQSS's GLOBALSTAR application filed on June 3, 1991.

many more pending)<sup>5/</sup> for various aspects of this pioneering research.

Qualcomm's CDMA research has been in progress since the mid-1980s, as evidenced by its filing on October 17, 1986, an application for a broad system patent describing the use of CDMA in the type of satellite system proposed by LQSS. U.S. Patent No. 4,901,307 (Exhibit A) was issued for this innovation in satellite communications. The use of CDMA achieves a much higher spectral efficiency than the use of other multiple access techniques.

This basic system patent covers the concept of "marginal isolation gain," a generic term for capacity gains through exploitation of such system elements as multiple beam antennas, polarization reuse, frequency reuse by adjacent satellites, co-coverage by adjacent satellites, power control, and voice-activity gating, all made possible through the use of spread spectrum CDMA techniques. Developing this ability to increase capacity is a true breakthrough in the design of satellite communications systems, now incorporated into GLOBALSTAR. Through GLOBALSTAR's CDMA system, limited spectrum can be used to provide not only radiodetermination but also voice and data services at a level of quality and reliability and with increased capacity over existing technology, thereby improving communications services available to the consumer.

Recently, several additional patents were issued covering innovative research embodied in the GLOBALSTAR system design for

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<sup>5/</sup> Pending patents have not been submitted with this supplement; the Commission will, however, be provided with relevant patents when granted.

the "soft handoff" system, RAKE receiver architecture, and a method for combining pseudo-random binary codes with orthogonal binary codes. The technology covered by these patents improves GLOBALSTAR call quality and system reliability.

° U.S. Patent No. 5,101,501 (Exhibit B) covers the invention of the "soft handoff" technique which is an integral part of the GLOBALSTAR system and will be essential to all LEO satellite systems. A soft handoff allows neighboring satellites to handover an ongoing call as satellites pass overhead with no detectable degradation in quality of service. Soft handoffs also allow neighboring satellites and neighboring beams of a single satellite to provide additional capacity for the system. As a result of Qualcomm's soft handoff technology, a GLOBALSTAR call would be maintained on the strongest signal with no noticeable breaks while the system switches the call between satellites. This innovation improves the reliability of service and reduces call disruption.

° U.S. Patent No. 5,103,459 (Exhibit C) was issued for the invention of a unique method of combining pseudo-random binary codes with orthogonal binary codes. This system combines the best features of the pseudonoise codes with orthogonal multiple access, and produces a reduction in mutual interference between users, resulting in greater use capacity for GLOBALSTAR, reduced fading effects, and improved link performance.

° U.S. Patent No. 5,109,390 (Exhibit D) covers the invention of a unique RAKE receiver architecture which allows multipath to be processed so as to achieve a diversity gain rather than have it result in fading, as is usually the case. Additionally, the RAKE

receiver works in conjunction with the soft handoff technique to permit simultaneous links to be maintained to two or more different beams or satellites, which improves link performance. By providing multipath diversity, this innovation improves the quality and reliability of communications using GLOBALSTAR by reducing the effects of fading and ensuring smooth handoffs to the satellite with the strongest signal.

Patents for additional pioneering technology employed in GLOBALSTAR are also provided as exhibits. U.S. Patent No. 5,107,225 (Exhibit E), issued recently, covers innovation for a high dynamic range closed loop automatic gain control circuit, which will contribute to maintaining a GLOBALSTAR call at a constant level of quality. U.S. Patent No. 5,099,204 (Exhibit F), also issued recently, covers a linear gain control amplifier; and U.S. Patent No. 5,056,109 (Exhibit G), issued at the end of last year, covers a method and apparatus for controlling transmission power in a cellular CDMA system.

Of course, CDMA is not the only innovative aspect of GLOBALSTAR. For example, the orbital design for GLOBALSTAR'S LEO satellites includes the unique features of phased deployment, worldwide coverage with minimum satellites, extremely simple transponder design based on simple bent pipe technology together with a small number of beam antennas, and technology to avoid costly, complex and unnecessary crosslinks. The simplicity of the satellite design is in fact a major innovation in its own right. See LQSS Comments in Support of Request for Pioneer's Preference,

at 2 (filed April 8, 1992); LQSS Request for Pioneer's Preference, at 10-11 (filed Nov. 4, 1991).

Issuance of the patents described above illustrates the innovative nature of the technology which is the subject of LQSS's request for a pioneer's preference. These patents also record that the innovations embodied in GLOBALSTAR were on the drawing board in the mid-1980's, establishing the GLOBALSTAR system as a true pioneering effort, and that research, development and implementation related to it were accomplished prior to efforts of other applicants.

III. GLOBALSTAR SYSTEM ELEMENTS IN THESE PATENTS HAVE BEEN TESTED OVER THE PAST SIX YEARS AND REPEATEDLY PROVEN FEASIBLE.

Various aspects of CDMA technology embodied in GLOBALSTAR and the patents described above have been undergoing experimentation and testing over the past six years. The technologies disclosed in U.S. Patent No. 4,901,307 and the other patents have been validated by this testing. The results of these tests not only show that GLOBALSTAR will provide beneficial service, but also that the technology for which patents have issued help make feasible the proposed satellite communications system.

A. CDMA satellite system tests. The use of CDMA for mobile communications was first conceived as a satellite system application, for which a test was designed and conducted at Lake Elsinore near San Diego, California (Exhibit H), following an initial study program (Exhibit I). The advantages of the techniques presented in U.S. Patent No. 4,901,307 were validated by this test.

This CDMA satellite system test was designed for use with L-band frequencies. Field tests were carried out in a propagation environment intended to represent the worst-case scenario. A full duplex base station terminal was located high on a mountain overlooking a valley where a full duplex mobile terminal was driven around in an ordinary passenger car.

The system was also operated successfully over a C-band satellite transponder in the base to mobile direction only to a mobile terminal in a passenger car being driven around Los Angeles.

These tests proved a number of points essential to the application of CDMA to mobile satellite systems. First, CDMA combined with powerful forward error correction (FEC) codes would allow operation of a satellite communications system at very low signal-to-noise ratios. Communication effectiveness despite such low signal-to-noise ratios is critical for development of a high capacity system which uses relatively low power satellites.

Second, the tests also demonstrated that the transmit power of the mobile terminal could be controlled so as to effectuate sharing of the single satellite transponder by a large number of mobile terminals, increasing the capacity of the system. Third, the system would be able to adapt so as to provide a larger share of transponder power to disadvantaged mobile terminals and a smaller share to normally advantaged terminals. Accordingly, additional power can be directed toward weaker signals without significantly degrading the quality of other signals.

Moreover, CDMA allows significant immunity to multipath fading. Direct sequence CDMA allows the individual paths that make up multipath to be resolved and to prevent the destructive addition that causes fading.

These tests, particularly the C-band satellite test, have direct application to the GLOBALSTAR system, and have demonstrated that the basic underlying technology functions as designed.

These tests also demonstrate that the research on satellite-delivered CDMA which led to GLOBALSTAR was developed and tested prior to any such efforts of Motorola, TRW and any other applicant. GLOBALSTAR is truly the product of pioneering innovations in the field of satellite communications technology, and is deserving of a pioneer's preference.

B. CDMA cellular telephony tests. Further development of CDMA technology was undertaken for application to cellular telephony in 1988. Testing a terrestrial CDMA system has direct relevance to the success of the GLOBALSTAR satellite system by providing further refinement and development of the technology. Moreover, these tests have demonstrated that beneficial products for consumer use would be developed from innovative CDMA technology.

In these tests, various aspects of the patented technology (e.g., capacity, modulation schemes, power control, soft handoffs, diversity reception) were exercised. Using the technology disclosed in these patents, an improvement in performance in the CDMA system was realized. These tests have fully verified the



advancement in the state of the art and the viability of the technology disclosed in the patents.

An experimental "breadboard system" was constructed consisting of two cell sites and one mobile terminal together with noise simulators for a large number of additional mobiles. This test system was first demonstrated in San Diego in November 1989 for the cellular industry. Further testing was performed in Manhattan, New York, in February 1990 to prove the operation of the system in a congested urban multipath environment of which Manhattan is the archetype.

A "brassboard system" was constructed in 1991 for further testing of cellular CDMA telephony. This system consisted of over 70 actual mobile terminals operating simultaneously with five cell locations together with a mobile switching center. The system was designed to demonstrate a complete cellular system, including connection to the PSTN, complete handoff facility between cells, call setup and tear-down, and to prove all the various claims for system performance, including capacity and call quality. See "CDMA Formal Field Test Report" (Exhibit J).

Since development of the brassboard system, the operation of the system has now been extended from the 800 MHz cellular band to the 1.8-2.0 GHz PCN frequency band. Additional tests of microcell operation, wireless local loop applications, and indoor microcell operations are now in progress.

For example, Qualcomm recently completed demonstration of its CDMA digital cellular system in Germany with the cooperation of

Deutsche Bundespost Telekom. The test was conducted in the 1.7-1.8 GHz band using two cells, two mobile terminals and one switch. As in the United States, CDMA is being considered in Europe for the next generation of mobile communications systems.<sup>6/</sup>

This testing program has succeeded in establishing that CDMA is the ultimate solution to spectrum efficiency and that high capacity can be achieved without a complex satellite system, such as Motorola's proposed system. Because of this extensive and successful testing program, LQSS has been able to demonstrate the viability of the GLOBALSTAR system without a complex and costly experimental program. As development progresses, designs will continue to be verified for correctness in the natural course of a well-planned system.

#### IV. CONCLUSION.

In this and its prior pleadings, LQSS has established that GLOBALSTAR is a true "pioneer" which incorporates innovative technology which will allow it to provide new and enhanced

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<sup>6/</sup> Tests on the terrestrial CDMA system are currently being conducted in Washington, D.C., and Geneva, Switzerland.

communications services to the public. Accordingly, LQSS's request for a pioneer's preference should be granted.

Respectfully submitted,

LORAL QUALCOMM SATELLITE SERVICES, INC.

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Dated: June 12, 1992

State of California  
County of San Diego

DECLARATION

I hereby certify that I am the technically qualified person responsible for reviewing the technical information in the preceding "Supplement to Request for Pioneer's Preference" of Loral Qualcomm Satellite Services, Inc., and that it is complete and accurate to the best of my knowledge and belief.

A handwritten signature in dark ink, appearing to read "Klein S. Gilhousen", written over a horizontal line.

Klein S. Gilhousen  
Vice President, Systems  
QUALCOMM Incorporated

Dated: June 11, 1992

**EXHIBIT A.**

[54] **SPREAD SPECTRUM MULTIPLE ACCESS COMMUNICATION SYSTEM USING SATELLITE OR TERRESTRIAL REPEATERS**

[75] Inventors: Klein S. Gilhousen, San Diego; Irwin M. Jacobs, La Jolla; Lindsay A. Weaver, Jr., San Diego, all of Calif.

[73] Assignee: Qualcomm, Inc., San Diego, Calif.

[21] Appl. No.: 921,261

[22] Filed: Oct. 17, 1986

[51] Int. CL<sup>4</sup> ..... H04J 13/00

[52] U.S. CL ..... 370/18; 375/1

[58] Field of Search ..... 370/18, 19, 95; 375/1

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(List continued on next page.)

Primary Examiner—Douglas W. Olms

Attorney, Agent, or Firm—Brown, Martin, Haller & McClain

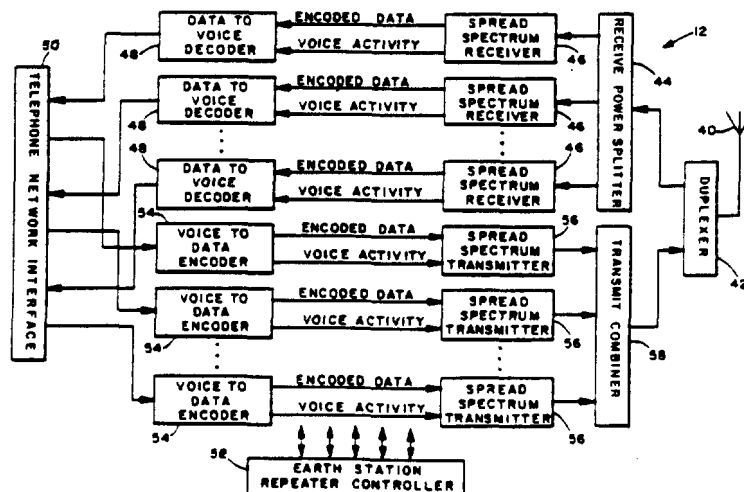
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**ABSTRACT**

A multiple access, spread spectrum communication system and method for providing high capacity communications to, from, or between a plurality of system users, using code-division-spread-spectrum communication signals. The communication system uses means for providing marginal isolation between user communication signals. The marginal isolation is provided by generating simultaneous multiple steerable beams; using an omni-directional antenna with polarization enhancement; using power control devices to adjust the output power for user generated communication signals either in response to their input activity level, or in accordance with a minimum allowable power for maintaining a communication link. The communication system can also employ a means for transmitting a predetermined pilot chip sequence contiguous with the code-division-spread-spectrum communication signals.

In further embodiments the communication system employs a plurality of user terminals linked to each other or to other services through one or more terrestrial or satellite repeaters. Multiple satellite repeaters are operable in a new communication mode to obtain further gains in signal isolation.

46 Claims, 11 Drawing Sheets



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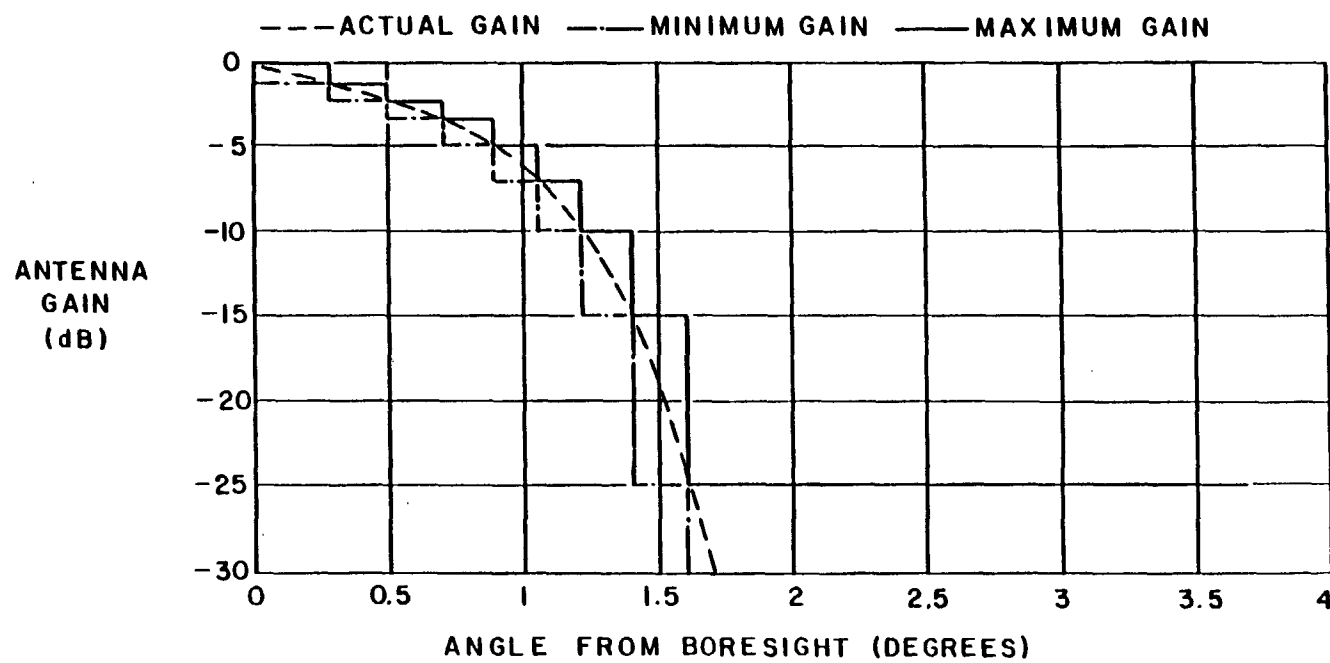


FIG. 1a



ANTENNA MARGINAL GAIN					
ATTN. RANGE (dB)		CUM. ANGLE (°)	$\Delta$ ANGLE (°)	# USERS (USERS)	WTD #USERS (USERS)
0	1	0.6	0.6	189	188.59
1	2	1.0	0.4	126	99.87
2	3	1.4	0.4	126	79.33
3	5	1.8	0.4	126	63.01
5	7	2.1	0.3	94	29.82
7	10	2.4	0.3	94	18.81
10	15	2.8	0.4	126	12.57
15	25	3.2	0.4	126	3.98
25	$\infty$	7.4	4.2	1320	4.17
TOTALS			7.4	2326	500.17
FDMA REUSE FACTOR			CDMA REUSE FACTOR		
2.64			4.65		

FIG. 1b

RELATIVE CAPACITY INCREASE AND POLARIZATION ISOLATION vs. ELLIPTICITY			
ELLIPTICITY (dB)	AXIAL RATIO	CAPACITY INCREASE	POLARIZATION ISOLATION (dB)
0.00	1.00	100 %	$-\infty$
2.00	0.63	79 %	-18.81
4.00	0.40	63 %	-12.91
6.00	0.25	50 %	-9.57
8.00	0.16	40 %	-7.32
10.00	0.10	32 %	-5.69
12.00	0.06	25 %	-4.46
14.00	0.04	20 %	-3.51
16.00	0.03	16 %	-2.78
18.00	0.02	13 %	-2.20
20.00	0.01	10 %	-1.74

FIG. 14